Dynamics of Solid Waste Management in Agra Smart City for Achieving Sustainable Development Goal 6 (Clean Water and Sanitation)

Synopsis

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INTRODUCTION:

Environmental governance advocates sustainability as the supreme consideration in managing all human activities – political, social, and economic. The concept of sustainability relies on sustainable development: the process of achieving long term goals (Mensah, J., & Ricart Casadevall, S. 2019). Sustainable development can be defined extensively, but the most recognized definition was phrased by the Brundtland Commission in 1987 and reported in 'Our Common Future': "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition partakes two concepts: first, 'needs', particularly the essential needs of the world's poor, to which overriding priority should be given; and second, the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs (WCED, 1987).

Sustainable development is based on the three pillars of sustainability (Economic, Environmental and Social sustainability), only achieved by the balancing of the pillars. This makes sustainable development a model for the twenty-first century (Hansmann, R., Mieg, H. A., & Frischknecht, P., 2012). The 5Ps of Sustainable Development are: People, Planet, Prosperity, Peace, and Partnership. Keeping these in mind the Millennium Development Goals (MDGs) was launched by the United Nations (UN) after adoption of Millennium Declaration by the General Assembly in 2000. The MDGs helped bringing out a much-needed focus and gravity on basic development issues, which in turn led the governments of developing countries to plan better implementation of more exhaustive policies and regulations (MDGs, India Country Report, 2014). There were several factors identified and said to have prevented India from meeting the MDGs' objectives (Final Country Report of India, 2017). The UN concerned with the narrow attention and dearth of inclusivity in 2015 introduced improved development goals as successor to MDGs, known as the Sustainable Development Goals (SDGs). The Sustainable Development Goals more comprehensive than MDGs interconnected an array of goals with its holistic approach of not leaving anyone behind and emphasis on linkage of global challenges (IPMC Ltd., 2023). The SDGs were formally articulated and adopted in a UNGA resolution known as the 2030 Agenda. On 6 July 2017, the SDGs were made more actionable by a UNGA resolution that identifies specific targets for each goal and provides indicators to measure progress. Most targets are to be achieved by 2030, although

some have no end date to reflect continuous improvement.

An overview of Sustainable Development Goals (SDGs) in India

Sustainable Development Goals were adopted by 193 countries including India succession to the MDGs. SDGs includes 17 goals and 169 targets and the deadline for several SDG targets are to be achieved before 2030 (UN General Assembly, 2015). India being a signatory member of declaration for sustainable development along with other countries played an important role in shaping the SDGs. At the United Nations Summit for Adoption of Post-2015 Development Agenda, PM Modi reaffirmed India's commitment by saying that "Today much of India's development agenda is mirrored in the SDGs". In India, various initiatives are taken by Government to achieve the target related to SDGs. India is ranked 112 out of 166 nations on the SDG Index with a score of 63.45 (Sustainable Development Report, 2023). NITI (National Institution for Transforming India) Aayog established as successor to Planning Commission by the current government of India in 2015 has been given the responsibility of curation and implementation of policies to achieve the SDGs. NITI Aayog's role is merely not to periodically collect data on SDGs but to act proactively fructifying the goals and targets, quantitatively with high standards of quality (Govt. of India, 2015). NITI Aayog divides 17 SDGs in to four categories which are related to Waste below:

Table 1: All SDGs are related to Waste Management

Social	SDG1-No Poverty	Waste picking is an important livelihood for the urban poor.
	SDG 2- Zero Hunger	Organic waste can fertilize new food.
	SDG 3- Good Health and Well-Being	Integrated waste management prevents diseases and food contamination
	SDG 4- Quality Education	Environmental and health training awareness.
	SDG 5- Gender Equality	Relieve undue burden of poor waste management on women.
	SDG 6- Clean Water and Sanitation	Better integrated waste management goes hand in hand with better wash.
Economic	SDG7-Affordable and Clean Energy	Waste to energy as an optional energy.
	SDG 8- Decent Work and Economic Growth	Green job growth in collection, reuse, recycling, and treatment.
	SDG 9- Industry, Innovation, and Infrastructure	Research and Development, recycling, and treatment innovation.
	SDG 10- Reduced Inequalities	Integrated waste management can increase the economic potential of the urban poor.

	SDG 11- Sustainable Cities and Communities	Integrated waste management make cities more sustainable.
Environmental	SDG 12- Sustainable Consumption and Production	Shift to waste reduction and resource management.
	SDG 13- Climate Action	Reduce greenhouse gases through less dumping and burning.
	SDG 14- Life below Water	Protect the marine environment from land-based activities.
	SDG 15- Life on Land	Less land pollution leads to healthier environment.
Fostering Peace and Partnership	SDG16-Peace, Justice, and Strong Institutions	Better governance of environment and resources.
	SDG17-Partnerships for the Goal	Work together and create public private partnerships.

(Source: NITI Aayog and WasteAid UK)

Operationalisation of the concept (meaning of waste, solid waste management and smart cities):

In Athens (500 B.C.) it was the responsibility of each household to taking their garbage to the disposal site located at a minimum of 1.5 kilometers from the city walls. With the Roman Empire, came the first garbage collection service. People threw their refuse into the streets from where it transported to an open pit, often located within the community, by horse-pulled carts. Centuries with no organized waste collection followed. Land was plentiful and people were few, so garbage was simply dumped in convenient places and forgotten. By the 1700s, litter had become a major problem, waste was still dumped in the streets and open burning of garbage was a common practice. And yet, it took another 150 years before scientific reports linking disease to filthy environmental conditions finally helped launch the 'age of sanitation' (Taras Foundation, 2020).

Since the Independence of the country, India has faced many issues and challenges in the path of development. One of those challenges which we are facing is the increase of Waste, which is domestic and industrial waste across the cities and towns.

Waste: Waste (or wastes) are unwanted or unusable materials. Waste is any substance discarded after primary use, or is worthless, defective and of no use. A by-product, by contrast is a joint product of relatively minor economic value. A waste product may become a by-product, joint product or resource through an invention that raises a waste product's value above zero. Examples include municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (feces and urine) and surface runoff), radioactive waste, and others. According to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes

and their Disposal of 1989, Article 2(1), "'Wastes' are substance or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law". Waste can be divided in many ways.

Solid wastes: These are the unwanted substances that are discarded by human society. These include urban wastes, industrial wastes, agricultural wastes, biomedical wastes, and radioactive wastes. Solid waste refers to any type of garbage, trash, refuse or discarded material. It can be categorized according to where the waste is generated, for example as municipal solid waste, health care waste and e-waste. (WHO, 2021)

Liquid wastes: Liquid waste is a major problem in the world, due to approximately 71% of the Earth's surface being covered in water. According to the Environmental Protection Agency (EPA), liquid waste is defined as any waste material that passes the definition of a "liquid." This means that the material must, "pass through a 0.45-micron filter at a pressure differential of 75 psi," according to the EPA's provided definition of a liquid. The main producers of liquid waste are animals and human beings as natural excretion of waste is flushed into sewage and waste lines. Wastes generated from washing, flushing, or manufacturing processes of industries are called liquid wastes.

Gaseous wastes: These are the wastes that are released in the form of gases from automobiles, factories or burning of fossil fuels like petroleum. They get mixed in the other gases atmosphere and occasionally cause events such as smog and acid rain.

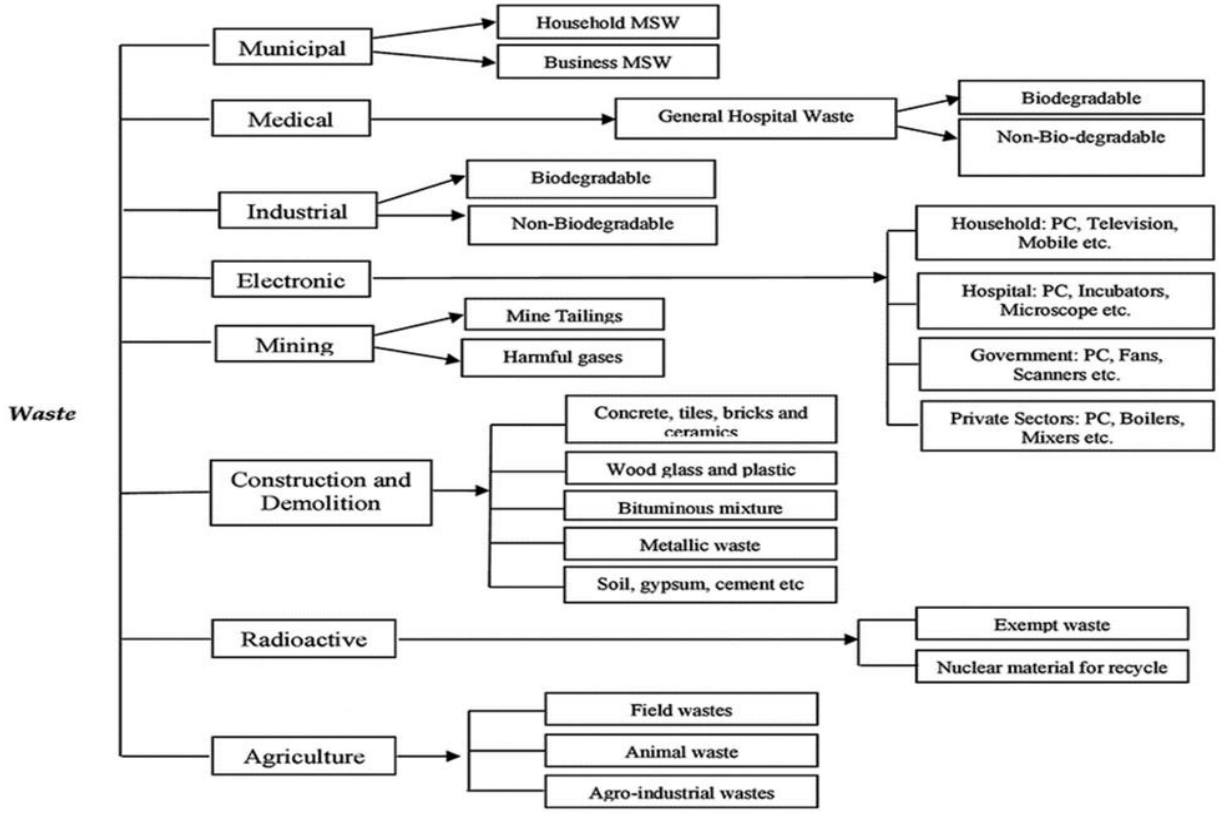

Fig. 1: The figure depicts the types of waste in form of Solid, Liquid and Gas (Source: Researchgate)

Solid Waste Management: The term solid waste management mainly refers to the complete process of collecting, treating, and disposing of solid wastes. In the waste management process, the wastes are collected from different sources and are disposed of. This process includes collection, transportation, treatment, analysis, and disposal of waste. The process of waste handling and disposal varies in different countries. In India, the processes differ according to the source of solid waste. They can be classified as: Municipal and Industry wastes. Municipal solid waste can further be divided into biodegradable, recyclable and hazardous domestic wastes. The biodegradable waste includes rotten food, vegetable peel and mostly wet kitchen waste. Recyclable waste includes plastic and hazardous wastes include bulb, batteries, etc. The industry generated waste from chemical factories, medical waste from hospitals is considered as Hazardous Solid Waste and they need special settings to dispose of them (Abdel-Shafy, H. I., & Mansour, M. S., 2018).

Smart Cities: A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban

transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population. (Smart Cities, European Commission, 2007)

Waste generation at worldwide and India level

Worldwide level- Around the world, waste generation rates are rising. In 2020, the world was estimated to generate 2.24 billion tonnes of solid waste, amounting to a footprint of 0.79 kilograms per person per day. With rapid population growth and urbanization, annual waste generation is expected to increase by 73% from 2020 levels to 3.88 billion tonnes in 2050. (Solid Waste Management, World Bank, 2022)

India level- The population of India crossed the 1.2 billion mark in 2013, and now it stands at 1.33 billion. With a population density of 325 per square kilometres, India's 2.9 million square kilometre of land area holds close to 18% of the world's population (Census 2011).

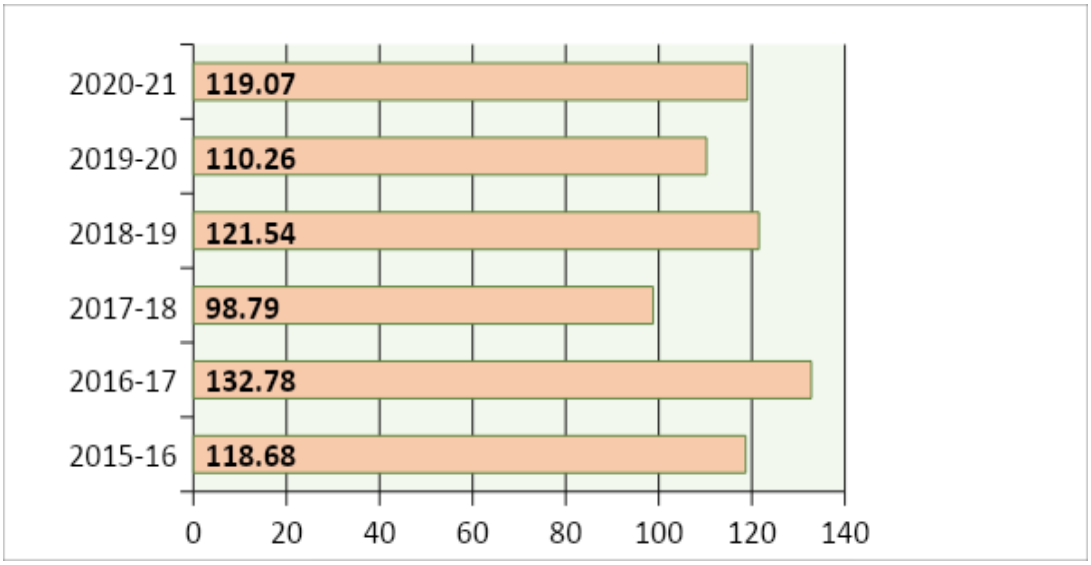

Fig. 2: India: Solid waste generation per capita (gm/day) from the last six years (Source: CPCB, Annual Report, 2020-21)

This figure depicts that India generates 160,038.9 tonnes of solid waste every day. Though over 95 per cent of the waste is collected, only about half of it is treated. While about 18 per cent is land-filled, almost a third of the total waste generated remains unaccounted for. And this has turned out to be a major concern for officials and civil society alike.

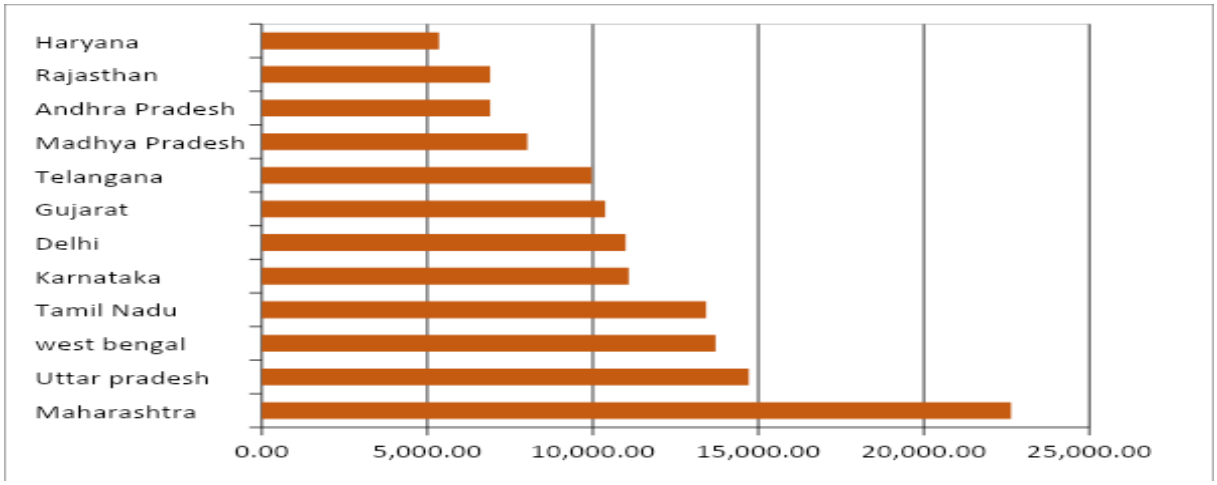

Fig. 3: Ranking of states in India on the basis of Solid waste generation (Source: Annual Report, CPCB, 2020-21)

This figure depicts that Maharashtra (22,632.71 tonnes per day), Uttar Pradesh (14,710 TPD) and West Bengal (13,709 TPD) generate the highest solid waste in the country. But while Maharashtra treats around two-thirds of the waste it generates, the number is an abysmal below 5 per cent for Bengal.

According to a report by The Energy and Resource Institute (TERI), India generates 62 million tonnes (61,000,000 long tons; 68,000,000 short tons) of waste each year. About 43 million tonnes (70%) are collected, of which about 12 million tonnes are treated, and 31 million tonnes are dumped in landfill sites. With changing consumption patterns and rapid economic growth, it is estimated that urban municipal solid waste generation will increase to 165 million tonnes in 2030. (Municipal Solid Waste Management in India- A Compendium Report, TERI, 2022)

Smart cities mission and sustainable development goals (6 & 11)

Smart cities mission: Cities accommodate nearly 31% of India's current population and contribute 63% of GDP (Census, 2011). Urban areas are expected to house 40% of India's population and contribute 75% of India's GDP by 2030 (Rajiv Gauba, 2017). This requires comprehensive development of physical, institutional, social, and economic infrastructure. All are important in improving the quality of life and attracting people and investment, setting in motion a virtuous cycle of growth and development. Development of Smart Cities is a step in that direction. The Smart Cities Mission is an innovative and new initiative by the Government of India to drive economic growth and improve the quality of life of people by enabling local development and harnessing technology as a means to create smart outcomes for citizens (Government of India, 2015). The aim of smart city mission was to improve the

infrastructure and drive economic growth in 100 cities of the country. This mission also aims to create replicable models of these cities that can inspire the country's other cities to become "Smart". Smart city mission help societies deal with socioeconomic and environmental challenges in urban areas. The Core infrastructure elements-

- Adequate water supply,
- Assured electricity supply,
- Sanitation, including solid waste management,
- Efficient urban mobility and public transport,
- Affordable housing, especially for the poor,
- Robust IT connectivity and digitalization,
- Good governance, especially e-Governance and citizen participation,
- Sustainable environment,
- Safety and security of citizens, particularly women, children and the elderly, and
- Health and education. (Govt. of India, 2015; UNGA, 2015)

In 2016, the first list of 20 cities was announced and the plan was to complete the development of these 20 cities by 2022. These 20 cities were: Ahmedabad, Bhubaneswar, pune, coimbotore, Jabalpur, Jaipur, Surat, Guwahati, Chennai, Kochi, Visakhapatnam, Indore, Bhopal, Udaipur, Ludhiana, Kakinada, Belagaum, Solapur and Bhuvanagiri as well as the area under the NDMC in New Delhi. In the subsequent rounds, more cities were added (Smart City, magic bricks, 2023). The Government has updated the list to 110 cities and Agra is one of them in state Uttar Pradesh. However, there are 12 cities of Uttar Pradesh selected for the smart city mission: Moradabad, Aligarh, Saharanpur, Bareilly, Jhansi, Kanpur, Allahabad, Lucknow, Varanasi, Ghaziabad, Agra and Rampur. India is a signatory to the 2030 Agenda for Sustainable Development and has committed to achieving inclusive, safe, resilient, and sustainable communities and settlements. India's urbanization story is one that is unprecedented with 483 million (34.9 per cent) people living in cities in 2020, and the share is expected to rise to 43 per cent in 2035. The 100 Smart Cities are representative of India's urban geography. The share of intermediary cities, with population between 100,000 to 1,000,000 persons, stands at 54 per cent (The Hindu, 2022; UN-Habitat. MoHUA, GoI. 2023). SCM offers a unique scale for SDG localization: the mission has

undertaken over 7,800 projects across 100 cities since its inception in 2015 and directed an investment of over USD 22 billion. These projects fall under the ambit of area-based developments (60 per cent of total projects) and pan-city smart solutions (40 per cent), which focus on the entire city, so no space is left behind, and all communities benefit from the mission's investments. The largest share of projects and investments are directed towards basic infrastructure and services which seek to improve the livability outcomes in the emerging urban areas. SCM is a unique case study of SDG localization. The three pillars of the mission—Livability, Economic-ability, and Sustainability—are aligned with 15 out of the 17 SDGs. Nearly 44 per cent of the total SCM projects contribute to SDG 11 (Sustainable Cities and Communities), SDG 6 (Clean Water and Sanitation) has the second largest share of projects at 13.3 per cent, followed by SDG 7 (Affordable and Clean Energy) at 8.6 per cent, and SDG 8 (Decent Work and Economic Growth) at 6.4 per cent. The pillars of Livability, Economic-ability, and Sustainability (LES) are linked to the 5Ps of SDGs. According to United Nations SDGs, the target of SDG 6 - Clean water and Sanitation-

Target 1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

Target 2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

Target 3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

Target 4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

Target 5 By 2030, implement integrated water resources management at all levels, including through trans-boundary cooperation as appropriate.

REVIEW OF LITERATURE:

In the existing literature, studies have focused on SDGs, SDG 6, Smart cities, Smart Cities Mission and impact of Solid waste management on smart cities mission. Review of some prominent studies is presented below.

Reviews on Smart cities and Sustainable Development Goals:

A paper on sustainable cities for sustainable development concluded that Smart cities are emerging as a crucial aspect of sustainable development, requiring a balance between development and environmental considerations (Maitra, 2021). Infrastructure such as roads, electricity, transportation, hospitals, and schools is essential for urban growth, but environmental and ecological issues must also be considered in economic and spatial planning. The three dimensions of policy integration in smart city development: horizontal integration across sectors and disciplines, vertical integration across different governmental levels, and a whole-of-society approach with the engagement of the private sector and civil society (Zheng et. Al, 2021). The concept of a smart sustainable city is still in its infancy, with only a few papers explicitly addressing smart and Sustainable Development Goals (SDGs) (Blasi et. al, 2022). Clement et. al (2023) Smart cities are primarily understood as domains for implementing smart technologies to improve urban processes efficiency. Strategies strongly support the localization of four Goals (SDGs 7, 8, 9, and 11) and several individual targets. However, for cities to promote sustainable development initiatives, careful attention must be paid to include initiatives on often untreated topics (SDGs 2, 5, and 15). Sharifi et. al (2024) concluded in their paper that responsible development and implementation of smart city solutions and technologies can contribute to progress towards SDGs.

Reviews on Solid waste management:

Jhaveri et. al (2021) the study presents a kit incorporating a micro-controller, ultrasonic sensors, and a Global system for mobile communication (GSM) module for waste management, aiming to achieve sustainable development goals such as clean water and sanitation, innovation and infrastructure, sustainable cities, and life on land. The innovative solution for municipality solid waste management can contribute to economic, social, and environmental sustainability. However, Yadav and Soni (2023) study reveals that key barriers to IoT-enabled waste management implementation include lack of government strict regulatory policies, proper financial planning, and benchmarking processes. Other potential barriers include lack of awareness among the community, source segregation and recycling commitment, and lack of service providers. The results can help policymakers identify and mitigate these barriers, enabling the development of programs, policies, and campaigns to achieve a zero-waste economy.

Reviews on India's Smart City Mission:

Adapa (2018) findings on ‘Indian smart cities and cleaner production initiatives – Integrated framework and recommendations’ reveals that academic experts have been largely unaware of the Indian government's smart cities development program and cleaner production measures. Dwevedi et. al (2018) suggested that the World Cities Report 2016 identified key environmental components for sustainable cities, including land and geography, climate, atmospheric pollution, water resources, energy, and urban green space and biodiversity. To promote sustainable development, the Indian government needs to ensure equitable resource use and integrate big data, ICT, and IoT into the natural environment. Bholey (2018) suggested in book ‘Contemporary concerns Strategic, Economic, Cyber, Gender and Beyond’ that Smart cities are expected to transform urban systems through technology, design, innovation, and policy reforms, aiming to achieve sustainable urbanization. India's model for smart cities should be one that can quickly and effectively respond to emerging socio-cultural-economic-technological spatial needs and reinvent itself. However, Mohan (2022) revealed some cities are behind in project execution due to the COVID-19 pandemic and administrative and financial factors. Dash (2023) the study confirmed that smart city-built environment dimensions of smart governance, smart economy, smart mobility, smart environment, and smart living positively relate to citizen quality of life, except for the smart people dimension. Citizen participation moderates the relationship between all six dimensions of the smart city-built environment and citizens' quality of life. India is using the Smart City Mission (SCM) and urban digitalization project to present itself as technologically advanced and attractive to national and global capitals. However, most documents overlook many of the problems entrenched in Indian cities. Digital technologies and data are not only presented as silver bullets but also as profitable, with the private sector playing a crucial policy role and benefiting from smart cities. Citizens are considered a single, homogenous category, expected to be entrepreneurial and tech-savvy.

Reviews on SDG 6 (Clean Water and Sanitation):

Bharat and Dkhar (2018) The SDG framework and the commitments under SDG 6 are crucial for the sustainability of ecosystem services in India. To achieve SDG 6, existing schemes and programs must be optimized at local levels, and adaptation measures under the National Water Mission's specific goals must align with SDG 6 targets. An integrated set of interventions with an implementation framework

should be conceived and implemented by Central and State governments, possibly coordinated by the NITI Aayog. Kapuria (2018) suggested that the community action is necessary to fund water delivery due to the capital intensity and endurance of surface water supply infrastructure. The scarcity of piped water in Kolkata is not due to lack of resources or infrastructure but rather problems with politics and governance. Roy and Pramanick (2019) reveal in their study that the future population increase is anticipated to cause a decline in the total internal renewable water resource and overall renewable water resource. Tortajada (2020) Research on microbial, chemical, radioactive, and emerging contaminants, monitoring of influents and effluents of water treatment plants, real-time monitoring of water as it passes through the treatment train, and additional assessments of common drinking water treatment processes are needed to identify changes in water quality caused by pathogens or chemical pollutants. Bharat et. al (2020) Water, sanitation, health, and hygiene policies and sectors must be well-coordinated and handled comprehensively. Achieving safe sanitation requires a significant shift in behavior, and programs at the national, state, and local levels must be enhanced and coordinated with campaigns to influence key stakeholders' behaviors. Sarkar and Bharat (2021) on achieving SDGs, the Government of India's initiative in implementing programs like the Swachh Bharat Mission and Har Ghar Jal has significant political support at both Central and State levels. Important policies, such as the NWP and NUSP, are being updated, and the National Policy on Safe Reuse of Treated Water (SRTW) is being newly introduced to address strategic gaps. The National Policy on Safe Reuse of Treated Water (SRTW) is being introduced by the Government of India at both Central and State levels to address the strategic gaps in sanitation services. The policy aims to provide comprehensive, sustainable, and accessible sanitation services to all, requiring a strong policy and legal framework that is periodically reviewed to keep pace with technologies, aspirations, and changing needs and challenges. The achievement of Sustainable Development Goals (SDGs) in coastal West African cities relies on addressing bad sanitation and hygiene related to urban metabolism, poor groundwater quality, and health risks. Projects have been developed to improve and maintain groundwater quality, promoting healthy living and sustainability. Biswas et. al (2022) study revealed that SDG 6 achiever States and UTs in rural India, such as Sikkim, Himachal Pradesh, Andaman, and Nicobar Islands, have 100% access to clean water for sanitation. Kufeoglu (2022) acknowledge that major investments in infrastructure and

governance of water provisioning are urgently needed to ensure public health and increase resilience for transmissible diseases and virus outbreaks.

RESEARCH GAP AND NEED OF THE STUDY:

Prior research has been conducted on waste management, India's Smart Cities Mission, and the Sustainable Development Goals. The first three SDGs have been addressed, as evidenced by other researches (for example: Bharat, G., Dkhar, N. B., & Abraham, M. (2020). Aligning India’s sanitation policies with the sustainable development goals (SDGs). The Energy and Resources Institute (TERI); Bhatnagar, A., Nanda, T. P., Singh, S., Upadhyay, K., Sawhney, A., & Swamy, D. R. R. (2018). Analysing the role of India’s smart cities mission in achieving sustainable development goal 11 and the new urban agenda. Sustainable Development Research in the Asia-Pacific Region: Education, Cities, Infrastructure and Buildings, 275-292; Blasi, S., Ganzaroli, A., & De Noni, I. (2022). Smartening sustainable development in cities: Strengthening the theoretical linkage between smart cities and SDGs. Sustainable Cities and Society, 80, 103793; Biswas, S., Dandapat, B., Alam, A., & Satpati, L. (2022). India's achievement towards sustainable Development Goal 6 (Ensure availability and sustainable management of water and sanitation for all) in the 2030 Agenda. BMC Public Health, 22(1), 1-16), but my study will concentrate on SDG 6, specifically how they are being implemented in India's Smart Cities, especially Agra. A dearth of research exists on the integration and optimization of solid waste management systems and technology, even though many smart cities have adopted separate waste management solutions. India's Smart Cities Mission aims to create sustainable and inclusive urban development in 100 cities across the country by focusing on areas such as solid waste management, water supply, sanitation, and affordable housing. As part of this mission, the government has set targets for improving waste management and increasing recycling and waste-to-energy initiatives. Therefore, there is a need for a study that focuses on the status of solid waste management in India's smart cities and assesses the effectiveness of existing initiatives in achieving SDG 6 targets. By conducting such a study, policymakers and urban planners can gain valuable insights into the challenges and opportunities in solid waste management in smart cities and develop effective strategies for achieving sustainable development goals related to waste management, sanitation, and urban sustainability. Additionally, the findings of the study can help inform future policy decisions and

investments in waste management infrastructure and technologies in India's smart cities.

JUSTIFICATION OF THE STUDY:

Prime Minister Narendra Modi launched the World's largest sanitation initiative, Clean India Mission, or Swachh Bharat Mission on the 145th birth anniversary of Mahatma Gandhi on October 2, 2014.The mission is aimed at improving the infrastructure for solid waste management. Promoting waste segregation, collection, processing, and recycling as well as changing public behavior through awareness campaigns and community engagement to create a culture of cleanliness are also part of the mission. *The Swachh Bharat Mission - Urban (SBM-U),* aims at making urban India free from open defecation and achieving 100% scientific management of municipal solid waste in the country. The second phase of SBM-U was launched on 1st October 2021, for a period of 5 years. The vision for SBM-U 2.0 is to achieve "Garbage Free" status for all cities by 2026. In Interim Budget of 2024, For Swachh Bharat Mission (Urban) ₹ 5,000 crore was allocated in the Budget against the Revised Estimate of ₹2,000 crore for 2022-23. (Budget, 2024). *The Swachh Bharat Mission - Gramin (SBM-G),* seeks to improve the levels of cleanliness in rural areas through Solid waste and Liquid Waste Management activities and making Gram Panchayats Open Defecation Free (ODF), clean and sanitized. Finance Minister Nirmala Sitharaman present the Interim Budget on February 1 allocated ₹ 7,192 crore for the Swachh Bharat Mission (Gramin) against the Revised Estimate of ₹5,000 crore in 2022-23. (Budget, 2024). Among 10 smart cities of Uttar Pradesh, Agra is at the third position in generating the Waste after Lucknow and Kanpur.

Agra city generates around 796 tonnes per day (TPD) of Solid waste which is 5.41% of total waste generated in U.P. (Centre for Science and Environment, 2020). However, this city is home to one of the most iconic landmarks in India, the Taj Mahal, which attracts millions of tourists each year. This influx of tourists creates a significant amount of solid waste that needs to be managed effectively to preserve the beauty and integrity of the city.

RESEARCH QUESTIONS:

1. What policies and regulations are in place in the Smart Cities of India to ensure proper SWM and support the achievement of SDG 6?
2. What are the current SWM practices in Agra City?

3. How does citizen participation and awareness play a role in Solid Waste Management in Agra City?
4. What are the economic implications of SWM and how do they influence the efforts towards SDG 6?
5. How SDG 6 affects other SDGs in Smart Cities?
6. How do the social aspects of SWM such as employment generation and Social inclusion contribute to achieving SDG 6 in Agra?

OBJECTIVES:

- To analyze the effectiveness of promotion of Sustainable Solid Waste Management practices in smart cities through the policies and regulations implemented by Indian government.
- To gain and insight of the status strategies of SWM practices in Agra smart city.
- To evaluate the barrier and challenges in implementation of sustainable SWM practices in Agra smart city.
- To recommend effective strategies to enhance implementation of SWM practices in Agra smart city.

RESEARCH DESIGN AND METHODOLOGY:

To accomplish the objectives of the study, the following research methodology is proposed:

Research design: Exploratory and Descriptive in nature

Dynamics of SWM 1. Linkages with other SDG 6, 7, 8 and 11.

2. Comparative analysis of SWM in Agra smart city with top ranking smart cities of India.

3. Public expenditure, Employment generation, Capital investment, Operations and Maintenance.

Data Collection: The relevant data will be collected from Secondary sources. It comprises of Reports available on respective Web sites, newspapers, Journals and Magazines.

Study Area: For study, Agra City will be taken in to consideration.

Duration of the Study: For analysis, period after year 2015 will be taken into consideration because India became a signatory in the UN General Assembly for adopting SDGs.

Statistical tools: For the data analysis PLS-SEM, Regression analysis will be used. Reason for using this tool is that the data collected will be qualitative in nature and its normalcy is unknown, as we will try to assess the effectiveness of present SWM practices in Agra. A construct of measurement model will be on probable observing indicators like: waste generation rate, sanitation coverage alongside latent

construct like SWM practices and SDG 6 achievement. The tool will be used to analyze the relationship, direct and indirect effects of observing indicators & latent construct.

Presentation tools: Graph chart, Pie chart and table will be used.

Societal and policy implications

Research on the solid waste management dynamics in Agra Smart City has important Societal and Policy implications for attaining SDG 6: clean water and sanitation.

Social Implications:

- Better waste management techniques can make Agra's citizens' surroundings cleaner and healthier by lowering the chance of disease transmission and water contamination.
- Appropriate waste management can also lead to the creation of jobs for the neighbourhood, promoting economic growth and reducing poverty.
- Long-term behavioural changes can result from raising public awareness of waste management issues and encouraging participation in trash management initiatives. This can help citizens feel more sustainable and responsible for the environment.

Policy Implications:

- By educating policymakers about the present obstacles and weaknesses in Agra Smart City's solid waste management system, the research findings will help them create focused interventions and plans that will enhance garbage collection, segregation, and disposal procedures.
- To penalize unlawful dumping and littering, encourage recycling and composting, and enforce waste management rules, policies and regulations might be put in place.
- Working together, local communities, businesses, and government organizations can create a more sustainable waste management system that supports SDG 6.

  To accomplish long-term environmental goals, a comprehensive strategy that tackles the societal and policy ramifications of waste management is needed, encouraging cooperation and creativity.

CHAPTER PLAN:

Chapter 1- Introduction

Chapter 2- Review of Literature

Chapter 3 – Solid Waste Management in Agra city – Current status and effectiveness

Chapter 4- Challenges in implementation of SWM practices in Agra smart city

Chapter 5 – Conclusion and Suggestions

REFERENCES:

- Abdel-Shafy, H. I., & Mansour, M. S. (2018). Solid waste issue: Sources, composition, disposal, recycling, and valorization. Egyptian Journal of Petroleum, 27(4), 1275-1290. https://doi.org/10.1016/j.ejpe.2018.07.003
- Adapa, S. (2018). Indian smart cities and cleaner production initiatives–Integrated framework and recommendations. *Journal of cleaner production*, 172, 3351-3366.
- Biswas, S., Dandapat, B., Alam, A., & Satpati, L. (2022). India's achievement towards sustainable Development Goal 6 (Ensure availability and sustainable management of water and sanitation for all) in the 2030 Agenda. BMC Public Health, 22(1), 1-16.
- Blasi, S., Ganzaroli, A., & De Noni, I. (2022). Smartening sustainable development in cities: Strengthening the theoretical linkage between smart cities and SDGs. *Sustainable Cities and Society*, 80, 103793.
- Bholey, M. Smart Cities and India's Model for Sustainable Urbanism. *Strategic, Economic, Cyber, Gender, and Beyond*, 57.
- Bharat, G., Dkhar, N. B., & Abraham, M. (2020). Aligning India's sanitation policies with the sustainable development goals (SDGs). *The Energy and Resources Institute (TERI)*
- Bharat, G. K., & Dkhar, N. B. (2018). *Aligning India's water resource policies with the SDGs*. TERI Discussion Paper. New Delhi: The Energy and Resources Institute
- Bhatnagar, A., Nanda, T. P., Singh, S., Upadhyay, K., Sawhney, A., & Swamy, D. R. R. (2018). Analysing the role of India's smart cities mission in achieving sustainable development goal 11 and the new urban agenda. Sustainable Development Research in the Asia-Pacific Region: Education, Cities, Infrastructure and Buildings, 275-292.
- Conti, M. E., & Simone, C. (2019). Smart cities: are they really sustainable. Happiness management and creativity in the XXI century: intangible capitals as a source of innovation, competitiveness and sustainable development. Comares, Granada, Spain, 5-22.

- Dash, A. (2023). Does citizens' participation moderate the relationship between the built environment and their quality of life in Indian smart cities? *Transforming Government: People, Process and Policy*, 17(4), 673-687.
- Dwevedi, R., Krishna, V., & Kumar, A. (2018). Environment and big data: Role in smart cities of India. *Resources*, 7(4), 64.
- Clement, J., Ruysschaert, B., & Crutzen, N. (2023). Smart city strategies–A driver for the localization of the sustainable development goals?. *Ecological Economics*, 213, 107941.
- Hansmann, R., Mieg, H. A., & Frischknecht, P. (2012). Principal sustainability components: empirical analysis of synergies between the three pillars of sustainability. *International Journal of Sustainable Development & World Ecology*, *19*(5), 451-459.
- Ismagiloiva, E., Hughes, L., Rana, N., & Dwivedi, Y. (2019). Role of smart cities in creating sustainable cities and communities: a systematic literature review. *In ICT Unbounded, Social Impact of Bright ICT Adoption: IFIP WG 8.6 International Conference on Transfer and Diffusion of IT, TDIT 2019, Accra, Ghana, June 21–22, 2019, Proceedings (pp. 311-324).* Springer International Publishing.
- Jhaveri, R. H., Shah, P. S., Patel, N. N., Patel, D. M., Thanki, S., Bhoi, A. K., & Bhatia, J. (2021). An ICT-based solid waste management system for smart cities: a case of municipality in India. *International Journal of Ad Hoc and Ubiquitous Computing, 38(1-3), 158-171.*
- Kapuria, P. (2018). Valuing Water for a Smart and Sustainable City: Lessons from Kolkata. *ORF Issue Brief No*, 271.
- Küfeoğlu, S. (2022). SDG-11: sustainable cities and communities. In Emerging Technologies: Value Creation for Sustainable Development (pp. 385-408). Cham: Springer International Publishing.
- Louis GE. A historical context of municipal solid waste management in the United States. Waste Manag Res. 2004 Aug;22(4):306-22. doi: 10.1177/0734242X04045425. PMID: 15462338.
- MAITRA, S. Sustainable Cities for Sustainable Development.
- Mensah, J., & Ricart Casadevall, S. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. Cogent Social Sciences, 5(1).

https://doi.org/10.1080/23311886.2019.1653531

- Mohan, A. (2022). Policy Assessment of SCM-Smart Cities Mission. Policy, 23
- Pierfrancesco, M. (2021). Smart sustainable cities: Smart approaches and analysis. *Economy of Region*, 17(3), 1004-1013.
- Purandare, U. (2023). The Language of Smart Cities. Using Discourse Analysis to Study India's Smart Cities Mission. *South Asia Multidisciplinary Academic Journal, (30).*
- Roy, A., & Pramanick, K. (2019). Analysing progress of sustainable development goal 6 in India: Past, present, and future. *Journal of environmental management*, 232, 1049-1065.
- Sarkar, S. K., & Bharat, G. K. (2021). Achieving Sustainable Development Goals in water and sanitation sectors in India. *Journal of Water, Sanitation and Hygiene for Development*, 11(5), 693-705.
- Suresh, P., & Ramachandran, S. (2016). Development of Smart Cities in India–Dream to Reality. *Scholedge International Journal of Business Policy & Governance, 3(6).*
- Totin Vodounon, H. S., Houédakor, K. Z., Amoussou, E., Azalou Tingbe, E. M., Nantob, M., Ayitchéhou, K. L., & Enoumodji, M. N. B. (2022). Contributing to the achievement of sustainable development goals: knowledge on water, sanitation and health risk in Cotonou and Lomé cities. *International Journal of Sustainable Development & World Ecology*, 29(2), 164-175.
- Tortajada, C. (2020). Contributions of recycled wastewater to clean water and sanitation Sustainable Development Goals. *NPJ Clean Water*, 3(1), 22.
- Yadav, H., Soni, U., & Kumar, G. (2023). Analysing challenges to smart waste management for a sustainable circular economy in developing countries: a fuzzy DEMATEL study. *Smart and Sustainable Built Environment*, 12(2), 361-384.
- Zheng, L., Kwok, W. M., Aquaro, V., & Qi, X. (2019, April). Digital government, smart cities and sustainable development. *In Proceedings of the 12th International Conference on Theory and Practice of Electronic Governance* (pp. 291-301)

Websites

- https://www.teriin.org/policy-brief/discussion-paper-aligning-indiassanitation-policies-sdgs
- https://www.researchgate.net/publication/329058185_Aligning_India's_water_resource_policies_

with_the_SDGs

- https://www.researchgate.net/publication/377108656_Smart_cities_and_sustainable_development_goals_SDGs_A_systematic_literature_review_of_co-benefits_and_trade-offs?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InNlYXJjaCIsInBhZ2UiOiJzZWFyY2giLCJwb3NpdGlvbiI6InBhZ2VIZWFkZXIifX0
- https://taras.org/2020/10/10/a-short-history-of-solid-waste-management/#:~:text=In%20the%20United%20States%2C%20the,cities%20offered%20garbage%20collection%20services.
- **https://u.osu.edu/wastemanagement/liquidwaste-anthony-ulman/**